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Forest Insect and Disease Management

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BIOLOGICAL
EVALUATION R2-77-14

LOSS OF ENGELMANN SPRUCE
SEEDLINGS
at Mt. Sopris Tree Nursery

Carbondale, Colorado

August 1977

Rocky Mountain Region

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PREPARED BY: Diane M. Hildebrand
Diane M. Hildebrand
Biological Technician
Plants

APPROVED BY:

G. L. Downing
G. L. DOWNING
Staff Director
Forest Insect and Disease Management

F. A. Dorrell
F. A. DORRELL
Deputy Regional Forester
State and Private Forestry

Forest Insect and Disease Management
State and Private Forestry
Rocky Mountain Region
USDA Forest Service
11177 W. 8th Avenue
Lakewood, Colorado 80225

INTRODUCTION

In the summer of 1977, large numbers of the spring planting of Engelmann spruce seedlings were observed dead in several areas that had been fumigated with Dowfume MC-33 in the fall of 1976. At the request of the assistant Nurseryman, Thomas D. Landis, a survey of the diseased areas was made in late August, 1977, by Diane Hildebrand, Ronald MacDonald, and Kent Eggleston, Biological Technicians, to determine the proportion of seedlings affected and the causal agents.

Based on tree and soil samples from several of the affected areas collected by Linnea Gillman, Biologist, in late July, 1977, Fusarium root disease was indicated as a possible cause. All seedlings sampled at that time yielded pathogenic *Fusarium* species in culture, except for some healthy seedlings from Block 22, Unit 1. In the August survey, further evidence for *Fusarium* spp. as causal agents was gained, but whether *Fusarium* spp. entered as primary or secondary pathogens is still unclear. Approximately 2,580 feet of Engelmann spruce beds were evaluated, with a total of 20% dead seedlings and only a few dying.

STUDY METHODS

The areas of diseased Engelmann spruce which were surveyed included Block 2, Units 1 through 9; Block 10, Unit 4; and Block 20, Units 1 and 2. The beds within each unit were divided into 12-foot segments, and each segment was rated by visual estimation of the percent of dead trees. A 12-foot segment with less than 10% of the trees dead was given a "G", healthy, rating. If 10 to 20% of the trees were dead, the segment was rated "L", light; and from 20 to 30% was rated "M", medium. When over 30% of the trees were dead the 12-foot segment was rated "H", heavy.

In each unit, 10% of the "H" heavy-rated segments, 5% of the "M" medium-rated, 5% of the "L" light-rated, and 5% of the "G" healthy-rated segments were sampled to check the visual estimation as follows: A metal sampling frame measuring 18 inches x 4 feet (the width of the bed) was placed across the bed in the middle of a 12-foot segment to be sampled. One die was rolled to determine which of the six rows of trees within the bed to sample. The number of dead and living trees within the sampling frame was counted at each

sample location, and the percent affected was determined. For a 5% sample of a given rating, every 20th 12-foot segment with the appropriate rating was sampled; and for a 10% sample, every 10th 12-foot segment was sampled. To limit the time spent on sampling in each unit, maximum numbers of segments sampled per unit for each rating were arbitrarily set at 15 segments rated H, 10 segments rated M, and 5 segments each for L and G ratings.

Six samples of seedlings and the soil around their roots were collected from various locations in Block 2 and taken to the FI&DM laboratory in Lakewood. The 6 samples included 3 samples each of healthy and dead seedlings. Seedlings were washed in cold running tap water and 2 roots placed on a plate of Fusarium selective medium after rinsing in either of 2 ways: each sample had 1 plate of roots rinsed with 1% Clorox solution followed by sterile water, and 1 plate of roots rinsed with just sterile water. After incubation for a few days in continuous light, plates were examined for the presence of *Fusarium* spp.

Soil samples were handled in the standard way for Fusarium population determinations: sample soil was screened into cups and allowed to dry for 5 days before inoculation of plates of Fusarium selective medium. For each soil sample, 5 plates were each inoculated with 1 ml of suspension consisting of 0.1 g of soil in 40 ml of 0.1% water agar. After 5 days incubation under continuous light, *Fusarium* spp. colonies were counted and propagules per gram of soil were determined.

RESULTS

The results of the samples counted to check the visual estimations of the percent of dead trees were as follows: The average percent of dead trees from all samples rated G (healthy), was 9%; for L (light) was 18%; for M (medium) was 19%, and for H (heavy) was 45%. The visual estimation was considered accurate for G (healthy) and H (heavy) ratings, but L (light) and M (medium) ratings tended to overlap. The inconsistency may be due to the small sample size consisting of a randomly chosen clump of trees amounting to 2% of the total trees in a 12-foot segment.

Based on the visual estimation, the proportion of dead trees was calculated for each unit surveyed. The results are shown in Table 1.

Engelmann spruce seedlings were washed and rinsed, and 2 entire roots were placed on each plate of Fusarium selective medium. Table 2 gives the results. Soil sampled with the seedlings from the 6 locations in block 2 was used to inoculate plates of Fusarium selective medium. Colonies were counted and population levels calculated. The results are also given in Table 2.

TABLE 1 PERCENT OF DISEASED ENGELMANN SPRUCE SEEDLINGS BY UNIT

Seed Sources	LOCATION		Number of 12-foot segments in Unit	% OF 12-FOOT SEGMENTS WITH GIVEN RATING			
	Block	Unit		G Healthy	L Light	M Medium	H Heavy
VII	2	1	85	0	0	46	54
V, VII	2	2	284	0	1	89	10
II	2	3	298	0	3	42	55
I	2	4	300	0	42	41	17
I	2	5	295	0	87	12	1
I, I, III	2	6	274	31	66	3	0
III	2	7	222	0	31	54	15
III	2	8	204	7	89	4	0
III, IV	2	9	156	14	80	6	0
V, VI	10	4	333	98	2	0	0
VII	20	1	66	41	59	0	0
VII	20	2	65	52	42	6	0

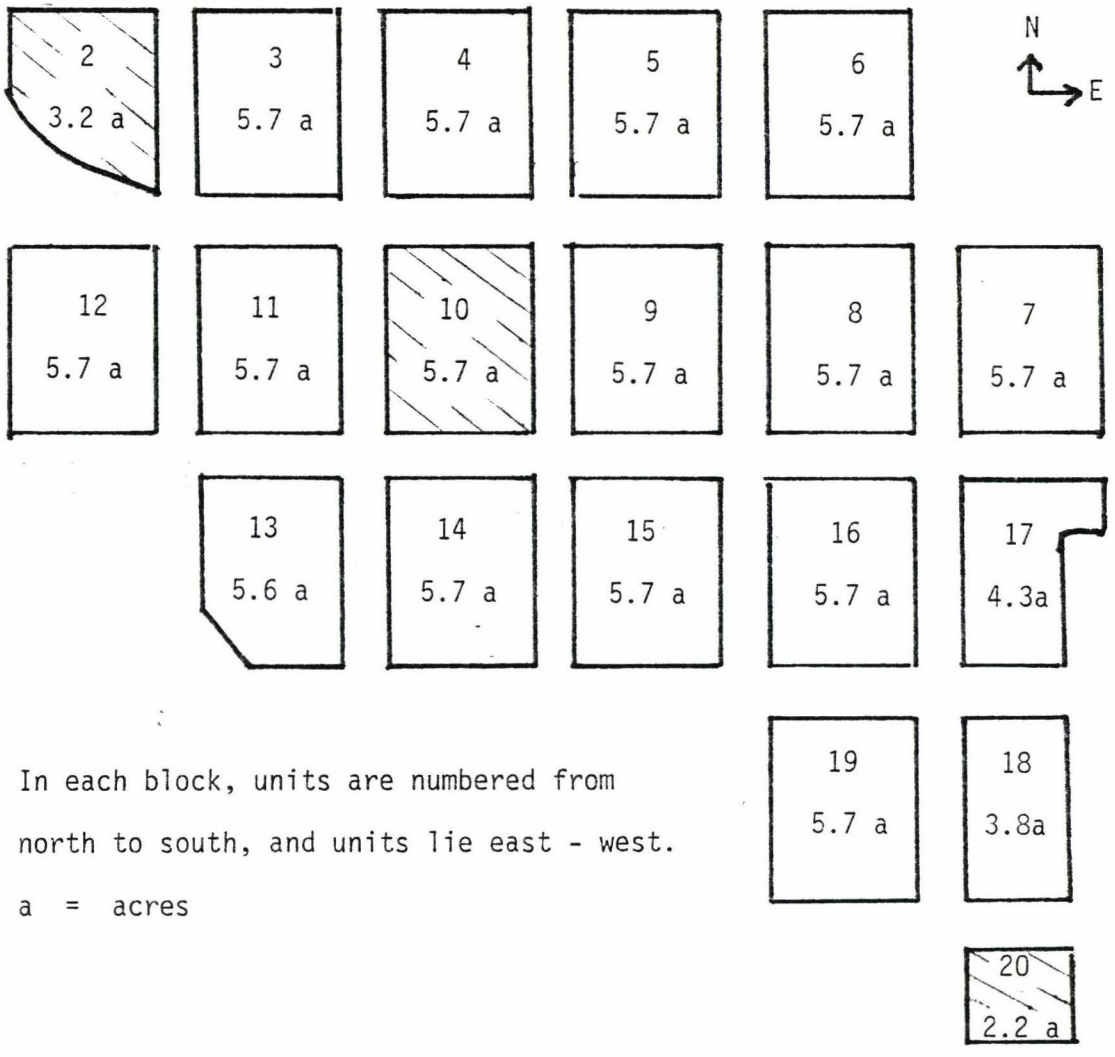
SEED SOURCES (NATIONAL FORESTS)

I	Grand Mesa, Uncompahgre
II	Medicine Bow
III	Pike and San Isabel
IV	White River
V	San Juan
VI	Carson (Region 3)
VII	Santa Fe (Region 3)

TABLE 2 OCCURRENCE OF *FUSARIUM* SPP. ON PLATED ROOTS OF ENGELMANN SPRUCE SEEDLINGS AND SOIL SAMPLES.

Sample locations	Condition of seedlings	Pathogenic *Fusarium* spp. isolated (+ or -)	Propagules per gram of soil
Block 2, Unit 7 Bed 4	Dead	+	5,040
Block 2, Unit 2 Bed 4	Dead	+	9,920
Block 2, Unit 4 Bed 5	Dead	+	3,520
Block 2, Unit 4 Bed 6	Healthy	+	1,040
Block 2, Unit 4 Bed 1	Healthy	+	1,760
Block 2, Unit 7 Bed 5	Healthy	no sample	1,200

FIGURE 1 LOCATIONS OF BLOCKS AT MT. SOPRIS TREE NURSERY



In each block, units are numbered from north to south, and units lie east - west.

a = acres

DISCUSSION

No consistent relationship between degree of damage and seed source is apparent (Table 1). Also, no pattern between location and degree of damage was revealed, except possibly that more seedlings are affected to the north. (See Figure 1 for relative location of blocks.)

The laboratory results reveal pathogenic species of Fusarium present everywhere in block 2, even around healthy seedlings. The population levels of pathogenic Fusarium in the soil around healthy seedlings, however, are very much lower than those in the soil near dead seedlings.

Even though high levels and overall occurrence of pathogenic *Fusarium* spp. have been demonstrated in the affected locations, Fusarium may or may not have been the cause. Because the Engelmann spruce seedlings had been already dead for some months before this survey, Fusarium may have flourished as only a secondary pathogen.

Next season, a similar survey should be initiated at the first sign of trouble and repeated samples taken for a few months to better determine whether *Fusarium* spp. are indeed the cause of this loss of Engelmann spruce.